
A.1 INTERNATIONAL SYSTEM OF UNITS

The decimal system of units was conceived in the sixteenth century when there was a great confusion and jumble of units of weights and measures. It was not until 1790, however, that the French National Assembly requested the French Academy of Sciences to work out a system of units suitable for adoption by the entire world. This system, based on the meter (meter) as a unit of length and the gram as a unit of mass, was adopted as a practical measure to benefit industry and commerce. Physicists soon realized its advantages and it was adopted also in scientific and technical circles. The importance of the regulation of weights and measures was recognized in Article 1, Section 8, when the U.S. Constitution was written in 1787, but the metric system was not legalized in this country until 1866. In 1893, the international meter and kilogram became the fundamental standards of length and mass in the United States, both for metric and customary weights and measures. The tables of conversion factors presented here are intended to serve two purposes (Tables A.1 and A.2):

1. To express the definitions of miscellaneous units of measure as exact numeral multiples of coherent “metric” units. Relationships that are exact in terms of the base unit are followed by an asterisk. Relationships that are not followed by an asterisk are either the results of physical measurements or are only approximate.
2. To provide multiplying factors for converting expressions of measurements given by numbers and miscellaneous units to corresponding new numbers and metric units.

Conversion factors are presented for ready adaptation to computer readout and electronic data transmission. The factors are written as a number equal to or greater than 1 and less than 10 with six or fewer decimal places. This number is followed by the letter E (for exponent), a plus or minus symbol, and two digits that indicate the power of 10 by which the number must be multiplied to obtain the correct value.

For example:

$$3.523\ 907\ \text{E}-02 \text{ is } 3.523\ 907 \times 10^{-2}$$

or

$$0.035\ 239\ 07$$

Similarly,

$$3.386\ 389\ \text{E}+03 \text{ is } 3.386\ 389 \times 10^3$$

or

$$3\ 386.389$$

An asterisk (*) after the sixth decimal place indicates that the conversion factor is exact and that all subsequent digits are zero. When a figure is to be rounded to fewer digits than the total number available, the procedure should be as follows:

1. When the first digit discarded is less than 5, the last digit retained should not be changed. For example, 3.463 25, if rounded to four digits, would be 3.463; if rounded to three digits, 3.46.
2. When the first digit discarded is greater than or if it is a 5, followed by at least one digit other than 0, the last figure retained should be increased by one unit. For example 8.376 52, if rounded to four digits, would be 8.377; if rounded to three digits, 8.38.
3. When the first digit discarded is exactly 5, followed only by zeros, the last digit retained should be rounded upward if it is an odd number, but no adjustment made if it is an even number. For example, 4.365, when rounded to three digits, becomes 4.36. The number 4.355 would also round to the same value, 4.36, if rounded to three digits.

Where fewer than six decimal places is shown, more precision is not warranted.

TABLE A.1a*International System of Units*

<i>Quantity</i>	<i>Unit</i>	<i>SI Symbol</i>	<i>Formula</i>
<i>Base units</i>			
length	meter	m	—
mass	kilogram	kg	—
time	second	s	—
electric current	ampere	A	—
thermodynamic temperature	kelvin	K	—
amount of substance	mole	mol	—
luminous intensity	candela	cd	—
<i>Supplementary units</i>			
plane angle	radian	rad	—
solid angle	steradian	sr	—
<i>Derived units</i>			
acceleration	meter per second squared	—	m/s^2
activity (of a radioactive source)	disintegration per second	—	(disintegration)/s
angular acceleration	radian per second squared	—	rad/s^2
angular velocity	radian per second	—	rad/s
area	square meter	—	m^2
density	kilogram per cubic meter	—	kg/m^3
electric capacitance	farad	F	$\text{A} \cdot \text{s/V}$
electrical conductance	siemens	S	A/V
electric field strength	volt per meter	—	V/m
electric inductance	henry	H	$\text{V} \cdot \text{s/A}$
electric potential difference	volt	V	W/A
electric resistance	ohm	Ω	V/A
electromotive force	volt	V	W/A
energy	joule	J	$\text{N} \cdot \text{m}$
entropy	joule per kelvin	—	J/K
force	newton	N	$\text{kg} \cdot \text{m/s}^2$
frequency	hertz	Hz	(cycle)/ s^2
illuminance	lux	lx	lm/m^2
luminance	candela per square meter	—	cd/m^2
luminous flux	lumen	lm	$\text{cd} \cdot \text{sr}$
magnetic field strength	ampere per meter	—	A/m
magnetic flux	weber	Wb	$\text{V} \cdot \text{s}$
magnetic flux density	tesla	T	Wb/m^2
magnetomotive force	ampere	A	—
power	watt	W	J/s
pressure	pascal	Pa	N/m^2
quantity of electricity	coulomb	C	$\text{A} \cdot \text{s}$
quantity of heat	joule	J	$\text{N} \cdot \text{m}$
radiant intensity	watt per steradian	—	W/sr
specific heat	joule per kilogram-kelvin	—	$\text{J/kg} \cdot \text{K}$
stress	pascal	Pa	N/m^2
thermal conductivity	watt per meter-kelvin	—	$\text{W/m} \cdot \text{K}$
velocity	meter per second	—	m/s
viscosity, dynamic	pascal-second	—	$\text{Pa} \cdot \text{s}$
viscosity, kinematic	square meter per second	—	m^2/s
voltage	volt	V	W/A
volume	cubic meter	—	m^3
wavenumber	reciprocal meter	—	(wave)/m
Work	joule	J	$\text{N} \cdot \text{m}$

TABLE A.1b*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
A		
abampere	ampere (A)	1.000 000*E+01
abcoulomb	coulomb (C)	1.000 000*E+01
abfarad	farad (F)	1.000 000*E+09
abhenry	henry (H)	1.000 000*E+09
abmho	siemens (S)	1.000 000*E+09
abohm	ohm (Ω)	1.000 000*E+09
abvolt	volt (V)	1.000 000*E+08
acre foot (U.S. survey) ^a	meter ³ (m ³)	1.233 489 E+03
acre (U.S. survey) ^a	meter ² (m ²)	4.046 873 E+03
ampere hour	coulomb (C)	3.600 000*E+03
are	meter ² (m ²)	1.000 000*E+02
angstrom	meter (m)	1.000 000*E−10
astronomical unit	meter (m)	1.495 979 E+11
atmosphere (standard)	pascal (Pa)	1.013 250*E+05
atmosphere (technical = 1 kgf/cm ²)	pascal (Pa)	9.806 650*E+04
B		
bar	pascal (Pa)	1.000 000*E+05
barn	meter ² (m ²)	1.000 000*E−28
barrel (for petroleum, 42 gal)	meter ³ (m ³)	1.589 873 E−01
board foot	meter ³ (m ³)	2.359 737 E−03
British thermal unit (International Table) ^b	joule (J)	1.055 056 E+03
British thermal unit (mean)	joule (J)	1.055 87 E+03
British thermal unit (thermochemical)	joule (J)	1.054 350 E+03
British thermal unit (39°F)	joule (J)	1.059 67 E+03
British thermal unit (59°F)	joule (J)	1.054 80 E+03
British thermal unit (60°F)	joule (J)	1.054 68 E+03
Btu (International Table) · ft/h · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	1.730 735 E+00
Btu (thermochemical) · ft/h · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	1.729 577 E+00
Btu (International Table) · in./h · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	1.442 279 E−01
Btu (thermochemical) · in./h · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	1.441 314 E−01
Btu (International Table) · in./s · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	5.192 204 E+02
Btu (thermochemical) · in./s · ft ² · °F (<i>k</i> , thermal conductivity)	watt per meter-kelvin (W/m · K)	5.188 732 E+02
Btu (International Table)/h	watt (W)	2.930 711 E−01
Btu (International Table)/s	watt (W)	1.055 056 E+03
Btu (thermochemical)/h	watt (W)	2.928 751 E+01
Btu (thermochemical)/min	watt (W)	1.757 250 E+01
Btu (thermochemical)/s	watt (W)	1.054 350 E+03
Btu (International Table)/ft ²	joule per meter ² (J/m ²)	1.135 653 E+04
Btu (thermochemical)/ft ²	joule per meter ² (J/m ²)	1.134 893 E+04
Btu (thermochemical)/ft ² · h	watt per meter ² (W/m ²)	3.152 481 E+00
Btu (thermochemical)/ft ² · min	watt per meter ² (W/m ²)	1.891 489 E+02
Btu (thermochemical)/ft ² · s	watt per meter ² (W/m ²)	1.134 893 E+04
Btu (thermochemical)/in. ² · s	watt per meter ² (W/m ²)	1.634 246 E+06
Btu (International Table)/h · ft ² · °F (<i>C</i> , thermal conductance)	watt per meter ² -kelvin (W/m ² · K)	5.678 263 E+00

(continued)

TABLE A.1b (continued)*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
Btu (thermochemical)/h · ft ² · °F (C, thermal conductance)	watt per meter ² -kelvin (W/m ² · K)	5.674 466 E+00
Btu (International Table)/s · ft ² · °F	watt per meter ² -kelvin (W/m ² · K)	2.044 175 E+04
Btu (thermochemical)/s · ft ² · °F	watt per meter ² -kelvin (W/m ² · K)	2.042 808 E+04
Btu (International Table)/lb	joule per kilogram (J/kg)	2.326 000*E+03
Btu (thermochemical)/lb	joule per kilogram (J/kg)	2.324 444 E+03
Btu (International Table)/lb · °F (c, heat capacity)	joule per kilogram-kelvin (J/kg · K)	4.186 800*E+03
Btu (thermochemical Table)/lb · °F (c, heat capacity)	joule per kilogram-kelvin (J/kg · K)	4.184 000 E+03
bushel (U.S.)	meter ³ (m ³)	3.523 907 E−02
C		
caliber (inch)	meter (m)	2.540 000*E−02
calorie (International Table)	joule (J)	4.186 800*E+00
calorie (mean)	joule (J)	4.190 02 E+00
calorie (thermochemical)	joule (J)	4.184 000*E+00
calorie (15°C)	joule (J)	4.185 80 E+00
calorie (20°C)	joule (J)	4.181 90 E+00
calorie (kilogram, International Table)	joule (J)	4.186 800*E+03
calorie (kilogram, mean)	joule (J)	4.190 02 E+03
calorie (kilogram, thermochemical)	joule (J)	4.184 000*E+03
cal (thermochemical)/cm ²	joule per meter ² (J/m ²)	4.184 000*E+04
cal (International Table)/g	joule per kilogram (J/kg)	4.186 800*E+03
cal (thermochemical)/g	joule per kilogram (J/kg)	4.184 000*E+03
cal (International Table)/g · °C	joule per kilogram-kelvin (J/kg · K)	4.186 800*E+03
cal (thermochemical)/g · °C	joule per kilogram-kelvin (J/kg · K)	4.184 000*E+08
cal (thermochemical)/min	watt (W)	6.973 333 E−02
cal (thermochemical)/s	watt (W)	4.184 000*E+00
cal (thermochemical)/cm ² · min	watt per meter ² (W/m ²)	6.973 333 E+02
cal (thermochemical)/cm ² · s	watt per meter ² (W/m ²)	4.184 000*E+04
cal (thermochemical)/cm · s · °C	watt per meter-kelvin (W/m · K)	4.184 000*E+02
carat (metric)	kilogram (kg)	2.000 000*E−04
centimeter of mercury (0°C)	pascal (Pa)	1.333 22 E+03
centimeter of water (4°C)	pascal (Pa)	9.806 38 E+01
centipoise	pascal second (Pa · s)	1.000 000*E−03
centistokes	meter ² per second (m ² /s)	1.000 000*E−06
circular mil	meter ² (m ²)	5.067 075 E−10
clo	kelvin meter ² per watt (K · m ² /W)	2.003 712 E−01
cup	meter ³ (m ³)	2.365 882 E−04
curie	becquerel (Bq)	3.700 000*E+10
D		
day (mean solar)	second (s)	8.640 000 E+04
day (sidereal)	second (s)	8.616 409 E+04
degree (angle)	radian (rad)	1.745 329 E−02
degree Celsius	Kelvin (K)	
degree centigrade	[see footnote ^c]	$t_K = t_{°C} + 273.15$
degree Fahrenheit	degree Celsius	$t_{°C} = (t_{°F} - 32)/1.8$
degree Fahrenheit	kelvin (K)	$t_K = (t_{°F} + 459.67)/1.8$
degree Rankine	kelvin (K)	$t_K = t_{°R}/1.8$
°F · h · ft ² /Btu (International Table) (R, thermal resistance)	kelvin meter ² per watt (K · m ² /W)	1.761 102 E−01
°F · h · ft ² /Btu (thermochemical) (R, thermal resistance)	kelvin meter ² per watt (K · m ² /W)	1.762 280 E−01

TABLE A.1b (continued)
Alphabetical List of Units

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
Denier	kilogram per meter (kg/m)	1.111 111 E−07
Dyne	newton (N)	1.000 000*E−05
dyne/cm	newton meter (N · m)	1.000 000*E−07
dyne/cm ²	pascal (Pa)	1.000 000*E−01
<i>E</i>		
Electronvolt	joule (J)	1.602 19 E−19
EMU of capacitance	farad (F)	1.000 000*E+09
EMU of current	ampere (A)	1.000 000*E+01
EMU of electric potential	volt (V)	1.000 000*E−08
EMU of inductance	henry (H)	1.000 000*E−09
EMU of resistance	ohm (Ω)	1.000 000*E−09
ESU of capacitance	farad (F)	1.112 650 E−12
ESU of current	ampere (A)	3.335 6 E−10
ESU of electric potential	volt (V)	2.997 9 E+02
ESU of inductance	henry (H)	8.987 554 E+11
ESU of resistance	ohm (Ω)	8.987 554 E+11
erg	joule (J)	1.000 000*E−07
erg/(cm ² · s)	watt per meter ² (W/m ²)	1.000 000*E−03
erg/s	watt (W)	1.000 000*E−07
<i>F</i>		
faraday (based on carbon-12)	coulomb (C)	9.648 70 E+04
faraday (chemical)	coulomb (C)	9.649 57 E+04
faraday (physical)	coulomb (C)	9.652 19 E+04
fathom	meter (m)	1.828 8 E+00
fermi (femtometer)	meter (m)	1.000 000*E−15
fluid ounce (U.S.)	meter ³ (m ³)	2.957 353 E−05
foot	meter (m)	3.048 000*E−01
foot (U.S. survey) ^a	meter (m)	3.048 006 E−01
foot of water (39.2°F)	pascal (Pa)	2.988 98 E+03
ft ²	meter ² (m ²)	9.290 304*E−02
ft ² /h (thermal diffusivity)	meter ² per second (m ² /s)	2.580 640*E−05
ft ² /s	meter ² per second (m ² /s)	9.290 304*E−02
ft ³ (volume; section modulus)	meter ³ (m ³)	2.831 685 E−02
ft ³ /min	meter ³ per second (m ³ /s)	4.719 474 E−04
ft ³ /s	meter ³ per second (m ³ /s)	2.831 685 E−02
ft ⁴ (moment of section) ^d	meter ⁴ (m ⁴)	8.630 975 E−03
ft/h	meter per second (m/s)	8.466 667 E−05
ft/min	meter per second (m/s)	5.080 000*E−03
ft/s	meter per second (m/s)	3.048 000*E−01
ft/s ²	meter per second ² (m/s ²)	3.048 000*E−01
footcandle	lux (lx)	1.076 391 E+01
footlambert	candela per meter ² (cd/m ²)	3.426 259 E+00
ft · lbf	joule (J)	1.355 818 E+00
ft · lbf/h	watt (W)	3.766 161 E−04
ft · lbf/min	watt (W)	2.259 697 E−02
ft · lbf/s	watt (W)	1.355 818 E+00
ft · poundal	joule (J)	4.214 011 E−02
free fall, standard (g)	meter per second ² (m/s ²)	9.806 650*E+00
<i>G</i>		
gal	meter per second ² (m/s ²)	1.000 000*E−02
gallon (Canadian liquid)	meter ³ (m ³)	4.546 090 E−03

(continued)

TABLE A.1b (continued)*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
gallon (U.K. liquid)	meter ³ (m ³)	4.546 092 E−03
gallon (U.S. dry)	meter ³ (m ³)	4.404 884 E−03
gallon (U.S. liquid)	meter ³ (m ³)	3.785 412 E−03
gallon (U.S. liquid) per day	meter ³ per second (m ³ /s)	4.381 264 E−08
gallon (U.S. liquid) per minute	meter ³ per second (m ³ /s)	6.309 020 E−05
gallon (U.S. liquid) per hp · h (SFC, specific fuel consumption)	meter ³ per joule (m ³ /J)	1.410 089 E−09
gamma	tesla (T)	1.000 000*E−09
gauss	tesla (T)	1.000 000*E−04
gilbert	ampere (A)	7.957 747 E−01
gill (U.K.)	meter ³ (m ³)	1.420 654 E−04
gill (U.S.)	meter ³ (m ³)	1.182 941 E−04
grad	degree (angular)	9.000 000*E−01
grad	radian (rad)	1.570 796 E−02
grain (1/7000 lb avoirdupois)	kilogram (kg)	6.479 891*E−05
grain (lb avoirdupois/7000)/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	1.711 806 E−02
gram	kilogram (kg)	1.000 000*E−03
g/cm ³	kilogram per meter ³ (kg/m ³)	1.000 000*E+03
gram-force/cm ²	pascal (Pa)	9.806 650*E+01
<i>H</i>		
hectare	meter ² (m ²)	1.000 000*E+04
horsepower (550 ft · lbf/s)	watt (W)	7.456 999 E+02
horsepower (boiler)	watt (W)	9.809 50 E+03
horsepower (electric)	watt (W)	7.460 000*E+02
horsepower (metric)	watt (W)	7.354 99 E+02
horsepower (water)	watt (W)	7.460 43 E+02
horsepower (U.K.)	watt (W)	7.457 0 E+02
hour (mean solar)	second (s)	3.600 000 E+03
hour (sidereal)	second (s)	3.590 170 E+03
hundredweight (long)	kilogram (kg)	5.080 235 E+01
hundredweight (short)	kilogram (kg)	4.535 924 E+01
<i>I</i>		
inch	meter (m)	2.540 000*E−02
inch of mercury (32°F)	pascal (Pa)	3.386 38 E+03
inch of mercury (60°F)	pascal (Pa)	3.376 85 E+03
inch of water (39.2°F)	pascal (Pa)	2.490 82 E+03
inch of water (60°F)	pascal (Pa)	2.488 4 E+02
in. ²	meter ² (m ²)	6.451 600*E−04
in. ³ (volume; section modulus) ^e	meter ³ (m ³)	1.638 706 E−05
in. ³ /min	meter ³ per second (m ³ /s)	2.731 177 E−07
in. ⁴ (moment of section) ⁴	meter ⁴ (m ⁴)	4.162 314 E−07
in./s	meter per second (m/s)	2.540 000*E−02
in./s ²	meter per second ² (m/s ²)	2.540 000*E−02
<i>K</i>		
kayser	1 per meter (1/m)	1.000 000*E+02
kelvin	degree Celsius	$t_{\text{C}} = t_{\text{K}} - 273.15$
kilocalorie (International Table)	joule (J)	4.186 800*E+03
kilocalorie (mean)	joule (J)	4.190 02 E+03
kilocalorie (thermochemical)	joule (J)	4.184 000*E+03
kilocalorie (thermochemical)/min	watt (W)	6.973 333 E+01
kilocalorie (thermochemical)/s	watt (W)	4.184 000*E+03

TABLE A.1b (continued)*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
kilogram-force (kgf)	newton (N)	9.806 650*E+00
kgf · m	newton meter (N · m)	9.806 650*E+00
kgf · s ² /m (mass)	kilogram (kg)	9.806 650*E+00
kgf/cm ²	pascal (Pa)	9.806 650*E+04
kgf/m ²	pascal (Pa)	9.806 650*E+00
kgf/mm ²	pascal (Pa)	9.806 650*E+06
km/h	meter per second (m/s)	2.777 778 E−01
kilopond	newton (N)	9.806 650*E+00
kW · h	joule (J)	3.600 000*E+06
kip (1000 lbf)	newton (N)	4.448 222 E+03
kip/in ² (ksi)	pascal (Pa)	6.894 757 E+06
knot (international)	meter per second (m/s)	5.144 444 E−01
<i>L</i>		
lambert	candela per meter ² (cd/m ²)	1/π *E+04
lambert	candela per meter ² (cd/m ²)	3.183 099 E+03
langley	joule per meter ² (J/m ²)	4.184 000*E+04
league	meter (m)	[see footnote a]
light year	meter (m)	9.460 55 E+15
liter ^f	meter ³ (m ³)	1.000 000*E−03
<i>M</i>		
maxwell	weber (Wb)	1.000 000*E−08
mho	siemens (S)	1.000 000*E+00
microinch	meter (m)	2.540 000*E−08
micron	meter (m)	1.000 000*E−06
mil	meter (m)	2.540 000*E−05
mile (international)	meter (m)	1.609 344*E+03
mile (statute)	meter (m)	1.609 3 E+03
mile (U.S. survey) ^a	meter (m)	1.609 347 E+03
mile (international nautical)	meter (m)	1.852 000*E+03
mile (U.K. nautical)	meter (m)	1.853 184*E+03
mile (U.S. nautical)	meter (m)	1.852 000*E+03
mi ² (international)	meter ² (m ²)	2.589 988 E+06
mi ² (U.S. survey) ^a	meter ² (m ²)	2.589 998 E+06
mi/h (international)	meter per second (m/s)	4.470 400*E−01
mi/h (international)	kilometer per hour (km/h)	1.609 344*E+01
mi/min (international)	meter per second (m/s)	2.682 240*E+01
mi/s (international)	meter per second (m/s)	1.609 344*E+03
millibar	pascal (Pa)	1.000 000*E+02
millimeter of mercury (0°C)	pascal (Pa)	1.333 22 E+02
minute (angle)	radian (rad)	2.908 882 E−04
minute (mean solar)	second (s)	6.000 000 E+01
minute (sidereal)	second (s)	5.983 617 E+01
month (mean calendar)	second (s)	2.628 000 E+06
<i>O</i>		
oersted	ampere per meter (A/m)	7.957 747 E+01
ohm centimeter	ohm meter (Ω · m)	1.000 000*E−02
ohm circular-mill per foot	ohm millimeter ² per meter (Ω · mm ² /m)	1.662 426 E−03
ounce (avoirdupois)	kilogram (kg)	2.834 952 E−02
ounce (troy or apothecary)	kilogram (kg)	3.110 348 E−02
ounce (U.K. fluid)	meter ³ (m ³)	2.841 307 E−05

(continued)

TABLE A.1b (continued)*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
ounce-force	newton (N)	2.780 139 E-01
ozf · in.	newton meter (N · m)	7.061 552 E-03
oz (avoirdupois)/gal (U.K. liquid)	kilogram per meter ³ (kg/m ³)	6.236 021 E+00
oz (avoirdupois)/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	7.489 152 E+00
oz (avoirdupois)/in. ³	kilogram per meter ³ (kg/m ³)	1.729 994 E+03
oz (avoirdupois)/ft ²	kilogram per meter ³ (kg/m ³)	3.051 517 E-01
oz (avoirdupois)/yd ²	kilogram per meter ³ (kg/m ³)	3.390 575 E-02
<i>P</i>		
parsec	meter (m)	3.085 678 E+16
peck (U.S.)	meter ³ (m ³)	8.809 768 E-03
pennyweight	kilogram (kg)	1.555 174 E-03
perm (0°C)	kilogram per pascal second meter ² (kg/Pa · s · m ²)	5.721 35 E-11
perm (23°C)	kilogram per pascal second meter ² (kg/Pa · s · m ²)	5.745 25 E-11
	kilogram per pascal second meter (kg/Pa · s · m)	1.453 22 E-12
perm · in. (0°C)	kilogram per pascal second meter (kg/Pa · s · m)	1.453 22 E-12
perm · in. (23°C)	kilogram per pascal second meter (kg/Pa · s · m)	1.459 29 E-12
phot	lumen per meter ² (lm/m ²)	1.000 000*E+04
pica (printer's)	meter (m)	4.217 518 E-03
pint (U.S. dry)	meter ³ (m ³)	5.506 105 E-04
pint (U.S. liquid)	meter ³ (m ³)	4.731 765 E-04
point (printer's)	meter (m)	3.514 598*E-04
poise (absolute viscosity)	pascal second (Pa · s)	1.000 000*E-01
pound (lb avoirdupois) ^e	kilogram (kg)	4.535 924 E-01
pound (troy or apothecary)	kilogram (kg)	3.732 417 E-01
lb · ft ² (moment of inertia)	kilogram meter ² (kg · m ²)	4.214 011 E-02
lb · in. ² (moment of inertia)	kilogram meter ² (kg · m ²)	2.926 397 E-04
lb/ft · h	pascal second (Pa · s)	4.133 789 E-04
lb/ft · s	pascal second (Pa · s)	1.488 164 E+00
lb/ft ²	kilogram per meter ² (kg/m ²)	4.882 428 E+00
lb/ft ³	kilogram per meter ³ (kg/m ³)	1.601 846 E+01
lb/gal (U.K. liquid)	kilogram per meter ³ (kg/m ³)	9.977 633 E+01
lb/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	1.198 264 E+02
lb/h	kilogram per second (kg/s)	1.259 979 E-04
lb/hp · h (SFC, specific fuel consumption)	kilogram per joule (kg/J)	1.689 659 E-07
lb/in. ³	kilogram per meter ³ (kg/m ³)	2.767 990 E+04
lb/min	kilogram per second (kg/s)	7.559 873 E-03
lb/s	kilogram per second (kg/s)	4.535 924 E-01
lb/yd ³	kilogram per meter ³ (kg/m ³)	5.932 764 E-01
poundal	newton (N)	1.382 550 E-01
poundal/ft ²	pascal (Pa)	1.488 164 E+00
poundal · s/ft ²	pascal second (Pa · s)	1.488 164 E+00
pound-force (lbf) ^h	newton (N)	4.448 222 E+00
lbf/ft	newton meter (N · m)	1.355 818 E+00
lbf · s/ft ²	pascal second (Pa · s)	4.788 026 E+01
lbf · s/in ²	pascal second (Pa · s)	6.894 757 E+03
lbf/ft	newton per meter (N/m)	1.459 390 E+01
lbf/ft ²	pascal (Pa)	4.788 026 E+01
lbf/in.	newton per meter (N/m)	1.751 268 E+02

TABLE A.1b (continued)*Alphabetical List of Units*

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
lbf/in. ² (psi)	pascal (Pa)	6.894 757 E+03
lbf/lb (thrust/weight [mass] ratio)	newton per kilogram (N/kg)	9.806 650 E+00
<i>Q</i>		
quart (U.S. dry)	meter ³ (m ³)	1.101 221 E−03
quart (U.S. liquid)	meter ³ (m ³)	9.463 529 E−04
<i>R</i>		
rad (radiation dose absorbed)	gray (Gy)	1.000 000*E−02
rhe	1 per pascal second (1/Pa·s)	1.000 000*E+01
rod	meter (m)	[see footnote a]
roentgen	coulomb per kilogram (C/kg)	2.58 E−04
<i>S</i>		
second (angle)	radian (rad)	4.848 137 E−06
second (sidereal)	second (s)	9.972 696 E−01
section	meter ² (m ²)	[see footnote a]
shake	second (s)	1.000 000*E−08
slug	kilogram (kg)	1.459 390 E+01
slug/ft·s	pascal second (Pa·s)	4.788 026 E+01
slug/ft ³	kilogram per meter ³ (kg/m ³)	5.155 788 E+02
statampere	ampere (A)	3.335 640 E−10
statcoulomb	coulomb (C)	3.335 640 E−10
statfarad	farad (F)	1.112 650 E−12
stathenry	henry (H)	8.987 554 E+11
statmho	siemens (S)	1.112 650 E−12
statohm	ohm (Ω)	8.987 665 E+11
statvolt	volt (V)	2.997 925 E+02
stere	meter ³ (m ³)	1.000 000*E−04
stilb	candela per meter ² (cd/m ²)	1.000 000*E+04
stokes (kinematic viscosity)	meter ² per second (m ² /s)	1.000 000*E−04
<i>T</i>		
tablespoon	meter ³ (m ³)	1.478 676 E−05
teaspoon	meter ³ (m ³)	4.928 922 E−06
tex	kilogram per meter (kg/m)	1.000 000*E−06
therm	joule (J)	1.055 056 E+08
ton (assay)	kilogram (kg)	2.916 667 E−02
ton (long, 2240 lb)	kilogram (kg)	1.016 047 E+03
ton (metric)	kilogram (kg)	1.000 000*E+03
ton (nuclear equivalent of TNT)	joule (J)	4.184 E+09 ⁱ
ton (refrigeration)	watt (W)	3.516 800 E+03
ton (register)	meter ³ (m ³)	2.831 685 E+00
ton (short, 2000 lb)	kilogram (kg)	9.071 847 E+02
ton (long)/yd ³	kilogram per meter ³ (kg/m ³)	1.328 939 E+03
ton (short)/yd ³	kilogram per meter ³ (kg/m ³)	1.186 553 E+03
ton (short)/h	kilogram per second (kg/s)	2.519 958 E−01
ton-force (2000 lbf)	newton (N)	8.896 444 E+03
tonne	kilogram (kg)	1.000 000*E+03
torr (mm Hg, 0°C)	pascal (Pa)	1.333 22 E+02
township	meter ² (m ²)	[see footnote a]
<i>U</i>		
unit pole	weber (Wb)	1.256 637 E−07

(continued)

TABLE A.1b (continued)
Alphabetical List of Units

<i>To Convert from</i>	<i>To</i>	<i>Multiply by</i>
<i>W</i>		
W · h	joule (J)	3.600 000 *E+03
W/cm ²	watt per meter ² (W/m ²)	1.000 000 *E+04
W/in ²	watt per meter ² (W/m ²)	1.550 003 E+03
<i>Y</i>		
yard	meter (m)	9.144 000 *E-01
yd ²	meter ² (m ²)	8.361 274 E-01
yd ³	meter ³ (m ³)	7.645 549 E-01
yd ³ /min	meter ³ per second (m ³ /s)	1.274 258 E-02
year (365 days)	second (s)	3.153 600 E+07
year (sidereal)	second (s)	3.155 815 E+07
year (tropical)	second (s)	3.155 693 E+07

Symbols of SI units given in parentheses.

^a Since 1893, the U.S. basis of length measurement has been derived from metric standards. In 1959, a small refinement was made in the definition of the yard to resolve discrepancies both in this country and abroad, which changed its length from 3600/3937 to 0.9144 m exactly. This resulted in the new value being shorter by two parts in a million.

At the same time it was decided that any data in feet derived from and published as a result of geodetic surveys within the United States would remain with the old standard (1 ft = 1200/3937 m) until further decision. This foot is named the U.S. survey foot.

As a result all U.S. land measurements in U.S. customary units will relate to the meter by the old standard. All the conversion factors in these tables for units referenced to this footnote are based on the U.S. survey foot, rather than the international foot.

Conversion factors for the land measures given below may be determined from the following relationships:

- 1 league = 3 miles (exactly)
- 1 rod = 16½ feet (exactly)
- 1 section = 1 square mile (exactly)
- 1 township = 36 square miles (exactly)
- 1 chain = 66 feet (exactly)

^b This value was adopted in 1956. Some of the older International Tables use the value 1.055 04 E+03. The exact conversion factor is 1.055 055 852 62 *E+03.

^c The SI unit of thermodynamic temperature is the kelvin (K), and this unit is properly used for expressing thermodynamic temperature and temperature intervals. Wide use is also made of the degree Celsius (°C), which is the SI unit for expressing Celsius temperature and temperature intervals. The Celsius scale (formerly called centigrade) is related directly to thermodynamic temperature (kelvins) as follows:

1. The temperature interval one degree Celsius equals one kelvin exactly.
2. Celsius temperature (t) is related to thermodynamic temperature (T) by the equation $t = T - T_0$, where $T_0 = 273.15$ K by definition.

^d This is sometimes called the moment of inertia of a plane section about a specified axis.

^e The exact conversion factor is 1.638 706 4 *E-05.

^f In 1964 the General Conference on Weights and Measures adopted the name liter as a special name for decimeter. Prior to this decision the liter differed slightly (previous value, 1.000028 dm³) and in expression of precision volume measurement this fact must be kept in mind.

^g The exact conversion factor is 4.535 923 7 *E-01.

^h The exact conversion factor is 4.448 221 615 260 5 *E+00.

ⁱ Defined (not measured) value.